



Pilot-Scale Soil Characterization Study



VBI70 Workgroup Meeting
April 20, 2000

PURPOSE

Determine whether the source of arsenic in residential soils can be identified by characterizing and comparing the physical and chemical characteristics of residential soils with potential sources such as arsenical herbicides or smelter wastes.

METHOD

Using several different types of analyses, characterize both site soils and potential sources.

- ◆ Metals ratios ("fingerprint")
- ◆ Bulk soil properties (Total organic carbon, soil pH, particle size distribution, etc.)
- ◆ Geochemical speciation (As, Pb, Cd, Zn, In, Tl, Hg, Sb, Se and perlite)
- ◆ *In vitro* bioaccessibility
- ◆ Stable lead isotope ratios

SAMPLE DESCRIPTION

Description	Sample Type	Sample Quantity
Residential	High[As] - Low[As] Pairs	3
	Intermediate [As] - Low[As] Pairs	3
	Low[As] - Low[As] Pairs	3
Potential Sources	Smelter Soil	4
	Smelter Material	1
	PAX (Arsenical Herbicide)	1
Background	Baseline Site Soil	1

PROJECT STATUS

- ◆ All analyses but stable lead isotope are underway.
- ◆ Feasibility evaluation of the stable lead isotope analysis is complete.

ESTIMATED PROJECT TIMELINE

- ◆ Receive final analytical results (May-June, 2000)
- ◆ Prepare draft report (June-July, 2000)

Table 2.1.1: Study Objective Hypotheses ^a

Test	H ₀ (Null Hypothesis)	H ₁ (Alternative Hypothesis)	Conclusion if H ₀ not rejected	Conclusion if H ₀ Rejected
Hypothesis 1	Physical characteristics (listed in Section 2.3) of soils having high (>900 ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having low (<70ppm) levels of arsenic.	Physical characteristics (listed in Section 2.3) of soils having high levels of arsenic <i>are</i> significantly different than characteristics of soils having low levels of arsenic.	<i>The physical characteristics measured in soils cannot be differentiated between soils with high and low arsenic levels.</i>	<i>The physical characteristics measured in soils can be differentiated between soils with high and low arsenic levels.</i>
Hypothesis 2	Physical characteristics (listed in Section 2.3) of soils having high (>900 ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having intermediate (>150-≤450ppm) levels of arsenic.	Physical characteristics (listed in Section 2.3) of soils having high levels of arsenic <i>are</i> significantly different than characteristics of soils having intermediate levels of arsenic.	<i>The physical characteristics measured in soils cannot be differentiated between soils with high and intermediate arsenic levels.</i>	<i>The physical characteristics measured in soils can be differentiated between soils with high and intermediate arsenic levels.</i>
Hypothesis 3	Physical characteristics (listed in Section 2.3) of soils having Intermediate (>150-≤450ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having low levels of arsenic.	Physical characteristics (listed in Section 2.3) of soils having intermediate levels of arsenic <i>are</i> significantly different than characteristics of soils having low levels of arsenic.	<i>The physical characteristics measured in soils cannot be differentiated between soils with intermediate and low arsenic levels.</i>	<i>The physical characteristics measured in soils can be differentiated between soils with intermediate and low arsenic levels.</i>
Hypothesis 4	Chemical characteristics of soils having high (>900 ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having low (<70ppm) levels of arsenic.	Chemical characteristics of soils having high levels of arsenic <i>are</i> significantly different than characteristics of soils having low levels of arsenic.	<i>The chemical characteristics measured in soils cannot be differentiated between soils of high and low arsenic levels.</i>	<i>The chemical characteristics measured in soils can be differentiated between soils of high and low arsenic levels.</i>
Hypothesis 5	Chemical characteristics of soils having high (>900 ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having intermediate (>150-≤450ppm) levels of arsenic.	Chemical characteristics of soils having high levels of arsenic <i>are</i> significantly different than characteristics of soils having intermediate levels of arsenic.	<i>The chemical characteristics measured in soils cannot be differentiated between soils of high and intermediate arsenic levels.</i>	<i>The chemical characteristics measured in soils can be differentiated between soils of high and intermediate arsenic levels.</i>

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Test	H₀ (Null Hypothesis)	H₁ (Alternative Hypothesis)	Conclusion if H₀ not rejected	Conclusion if H₀ Rejected
Hypothesis 6	Chemical characteristics of soils having intermediate (>150-≤450ppm) levels of arsenic <i>are not</i> significantly different than characteristics of soils having low (<70ppm) levels of arsenic.	Chemical characteristics of soils having intermediate levels of arsenic <i>are</i> significantly different than characteristics of soils having low levels of arsenic.	<i>The chemical characteristics measured in soils cannot be differentiated between soils of intermediate and low arsenic levels.</i>	<i>The chemical characteristics measured in soils can be differentiated between soils of intermediate and low arsenic levels.</i>
Hypothesis 7	The "fingerprint" developed for physical characteristics of soils having high levels of arsenic is <i>not</i> significantly different than the "fingerprint" developed for the physical characteristics of potential source materials.	The "fingerprint" developed for physical characteristics of soils having high levels of arsenic is significantly different than the "fingerprints" developed for the physical characteristics of potential source materials.	<i>Data collected from the physical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the physical characteristics measured in soils are sufficient for use in source attribution.</i>
Hypothesis 8	The "fingerprint" developed for physical characteristics of soils having intermediate levels of arsenic is <i>not</i> significantly different than the "fingerprint" developed for the physical characteristics of potential source materials.	The "fingerprint" developed for physical characteristics of soils having intermediate levels of arsenic is significantly different than the "fingerprints" developed for the physical characteristics of potential source materials.	<i>Data collected from the physical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the physical characteristics measured in soils are sufficient for use in source attribution.</i>
Hypothesis 9	The "fingerprint" developed for physical characteristics of soils having low levels of arsenic is <i>not</i> significantly different than the "fingerprint" developed for the physical characteristics of potential source materials.	The "fingerprint" developed for physical characteristics of soils having low levels of arsenic is significantly different than the "fingerprints" developed for the physical characteristics of potential source materials.	<i>Data collected from the physical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the physical characteristics measured in soils are sufficient for use in source attribution.</i>
Hypothesis 10	The "fingerprint" developed for chemical characteristics of soils having high levels of arsenic is <i>not</i> significantly different than the "fingerprints" developed for the chemical characteristics of potential source materials.	The "fingerprint" developed for chemical characteristics of soils having high levels of arsenic is significantly different than the "fingerprint" developed for the chemical characteristics of potential source materials.	<i>Data collected from the chemical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the chemical characteristics measured in soils are sufficient for use in source attribution.</i>

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Test	H ₀ (Null Hypothesis)	H ₁ (Alternative Hypothesis)	Conclusion if H ₀ not rejected	Conclusion if H ₀ Rejected
Hypothesis 11	The "fingerprint" developed for chemical characteristics of soils having intermediate levels of arsenic is not significantly different than the "fingerprints" developed for the chemical characteristics of potential source materials.	The "fingerprint" developed for chemical characteristics of soils having intermediate levels of arsenic is significantly different than the "fingerprint" developed for the chemical characteristics of potential source materials.	<i>Data collected from the chemical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the chemical characteristics measured in soils are sufficient for use in source attribution.</i>
Hypothesis 12	The "fingerprint" developed for chemical characteristics of soils having low levels of arsenic is not significantly different than the "fingerprints" developed for the chemical characteristics of potential source materials.	The "fingerprint" developed for chemical characteristics of soils having low levels of arsenic is significantly different than the "fingerprint" developed for the chemical characteristics of potential source materials.	<i>Data collected from the chemical characteristics measured in soils are not sufficient for use in source attribution.</i>	<i>Data collected from the chemical characteristics measured in soils are sufficient for use in source attribution.</i>

^a - the significance of observed differences will be a qualitative determination, using a weight-of-evidence approach.

All conclusions will be peer-reviewed by a soil scientist.